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FOR

Improved Phone Plug for a Phone Line System Including A Home Data Network

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Improved Phone Plug for a Phone Line System Including A Home Data Network

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to electronic connectors and more particularly relates to an improved phone plug for telephones that share a home data network implemented upon a phone line system in a residential home.

Description of the Related Art

The Internet is a rapidly growing communication network of interconnected computers and computer networks around the world. Together, these millions of connected computers form a vast repository of multimedia information that is readily accessible by any of the connected computers from anywhere at any time. Just as there is a critical need for high-speed connections to the information on the Internet, there is a growing need to rapidly move information between devices within a home, for example, data transferring from a first computing device in one room to a second computing device in another room. Businesses accomplish this by deploying Local Area Networks (LANs); however, networks are not commonly deployed in the home due to the cost and complexity of installing the new wiring system typically required by the traditional LANs. Nevertheless, there exists a phone line system in nearly every home in the United States. Therefore a demand for a simple

high-speed and cost-effective home network based on the existing phone line system is tremendously growing.

The driving force behind the home network is the growth of on-line households and the growing number of homes with two or more personal computers. It is reported that more than 47 percent of US households are likely to have Internet access devices by 2002, with some 20 percent of this subset owning multiple devices that need to share access to the Internet as well as each other. With the increased focus on computers in education and the boom in Internet connectivity, a large number of personal computers being purchased today are additional personal computers, as opposed to replacement units. Today, it is estimated that over 15 million of the nearly 100 million homes in the United States have two or more personal computers. This number is growing 30 percent annually.

Figure 1 shows a home data network over an existing wiring structure in a residential home. There is a computer **102** and a printer **104** coupled to a pair of phone lines **100** for data communication therebetween. The phone lines **100** are pre-existent and primarily for the telephone **106** or **108** for voice communication with the outside world through the public switched telephone network (PSTN) **110**. It is generally understood that each telephone device presents small capacitance to the phone lines **100**. Typically, the frequency of voice communication is low and hence the capacitance does not affect the voice communication over the phone lines **100**. When the same phone lines **100** are used for data communication with the capacitance from the coupled telephone devices, the capacitance can significantly affect the signal quality of the data communication between the computing devices. The

reason is primarily due to the very high signal frequency in the data communication. There is therefore, a great need for a cost-effective solution that can alleviate the effect from the capacitance of the telephone devices in data communication over a data network implemented upon a telephone line system.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above described problems and needs. The disclosed invention provides a simple generic solution to the capacitance problem introduced by telephone devices coupled onto a phone line system upon which a data network is implemented. The capacitance results in low impedance (loading effects) across the data network when high frequency data are transmitted therein. As a result, the data signals available to a computing device becomes degraded due to the high impedance. An improved phone plug disclosed herein uses an inductance circuit to block the loading effects so as to maintain the signals quality.

According to one embodiment of the present invention, the inductance circuit comprises an inductor. The improved phone plug comprises a housing having a rear-receiving end and a plugging end, a number of inductors and conductors. The plug-receiving socket is formed in the rear-receiving end and adapted to receive a modular phone plug; the plugging end being so formed that the plugging end can be plugged into a regular phone jack coupled to the phone line system including the data network. The conductors are mounted in the housing and have first ends and second ends; the first ends projecting into the plug-receiving socket for engaging a contact of the modular phone plug when the modular phone plug is inserted into the plug-receiving socket; the second ends coupled respectively to the plugging end through the inductors.

In other words, rather than having a telephone device connected to the phone line system directly, the telephone device is

coupled to the phone line system through inductors so as to minimize the capacitance impact on the data communication.

Accordingly, one of the objects of the present inventions is to provide a simple and generic solution to minimizing the capacitance impact from phone devices on the data communication.

Other objects, together with the foregoing are attained in the exercise of the invention in the following description and resulting in the embodiment illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings where:

Figure 1 shows a home data network over an existing wiring structure in a residential home;

Figure 2 shows a home configuration in which the present invention may be practiced;

Figure 3A illustrates an example of how three wall outlets (phone jack sockets) are coupled to a pair of wires of an existing 4-wire phone line system, commonly in a residential home;

Figure 3B shows a possible home network interface in a network card that can be in a computing device;

Figure 3C shows a connection of **Figure 3A** in conjunction of **Figure 3B** from a circuit perspective;

Figure 4A shows one exemplary phone plug in which the present invention may be practiced; and

Figure 4B shows an internal layout of improved phone plug.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, in which like numerals refer to like parts throughout the several views. **Figure 2** shows a home configuration in which the present invention may be practiced. As shown in the figure, there are four rooms **202**, **204**, **206** and **208** in the house **200**, each having electronic devices that are coupled to a home data network. The home data network is implemented upon a phone line system in the house **200** and may be coupled to the Internet via an internet service provider access device **232**.

With reference to the figure, there is a multimedia personal computer **210** and a scanner **212** in the kids bedroom **202**, a telephone **214** and laptop personal computer **216** in the master bedroom **204**, a desktop personal computer **218**, a printer **206**, a telephone **224** and a fax machine **222** in the home office ~~206~~ 220, and a video camera **226**, a telephone **228** and a set top box **230** in the home entertainment area **208**. To be more specific, telephones **214**, **224** and **228** and fax machine **222** are generally coupled to the phone line system for phone services while other devices, referred to herein as computing devices, are coupled to the phone line system for home data networking. Each of the computing devices may share data produced in another device. For example, The scanner **212** in the kids room generates an image of a picture, the image can be transmitted to the personal computer **218** for further editing process and finally the edited image can be printed from the laser printer **220**, all via the home data network.

Graphically, the home data network is overlapping the phone line system because it is implemented over the phone line system. Although all devices are connected to the same phone line system, only telephones **214**, **224** and **228** and fax machine **222** communicate with the public switched telephone network (PSTN) **256**. The rest of the devices communicate over the home data network may or may not communicate with PSTN **256** but communicate among themselves.

Figure 3A illustrates an example of how three wall outlets (phone jack sockets) **302**, **304** and **306** are coupled to a pair of wires **300** of an existing 4-wire phone line system, commonly in a residential home. Each of the wall outlets **302**, **304** and **306** has two pairs of connectors. It is assumed that the center two connectors are used for connection to wires **300**. As illustrated in the figure, device ~~308~~ 300, phone **310** and device **312** are coupled to wires **308** through outlets **302**, **304**, and **306**, respectively. For example, device **308** is a computer and device **312** is a printer. One application of the data communications between two devices **308** and **312** is to print on device **312** data from device **308**.

Figure 3B shows a possible home network interface **320** in a network card that can be in a computing device, such as device **308** and device **312**, for data communication over the phone line system. The interface **320** comprises two differential transmitters **322** and **324**. Differential transmitters **322** and **324** are respectively referred to as the primary and secondary differential transmitters, indicating that the primary differential transmitter is coupled to one pair of wires and the secondary differential transmitter is coupled to the secondary pair of wires in the phone line system. Each of the differential transmitters **322** and **324** is coupled to the telephone

line system via a respective line isolator **326** or **328**. It is understood to those skilled in the art that the line isolator **326** or **328** used herein is to decouple the differential transmitter from the regular telephone service access. There are many available isolators such as capacitor isolator or transformer isolator that may be used.

As shown in the figure, a data stream to be communicated over the home network is fed to both differential transmitters **322** and **324** that further send the data stream to both pairs of wires in the phone line system, thereby all devices coupled to the phone line system, regardless which pair of wires being coupled onto, can receive the data stream.

Because the transmission from a computing device that transmits the data stream is coming from both pairs of the wires, namely either one of the pairs of wires in the phone line system, there is, therefore, needed only one differential receiver. Hence the interface **320** further comprises a differential receiver **330**, coupled to one of the line isolators **326** or **328** to receive a data stream from the home network.

Referring to **Figure 3C** now, there is shown a connection of **Figure 3A** in conjunction of **Figure 3B** from a circuit perspective. A telephone set being plugged to a jack socket (e.g. a RJ11 jack) presents a capacitor **340** across the data network. If it is assumed that the output impedance of each of the interface is 100 Ω and the capacitance C of the capacitor is 1000 PF. At 7.5 MHz, the impedance of the capacitor will be approximated:

$$1/\omega C = 1/(2x\pi x7.5x10^{6}x1000x10^{-12}) \approx 21\Omega;$$

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If it is further assumed that the voltage available to a differential receiver in a network interface is 1.2 V, then the actual voltage received by the differential receiver in the network interface is approximated:

$$1.2x21/(100+21) = 0.2 V;$$

which shows that data signals received for data communication have been considerably degraded due to the capacitance from a telephone device.

Figure 4A shows one exemplary phone plug in which the present invention may be practiced. Phone plug **400**, housed in a housing or case that is preferably made out of solid plastic material, comprises two parts, a plugging end **402** and a rear-receiving end **404**. Plugging end **402** is just like a corresponding portion of a regular phone plug assembly and can be inserted into a regular phone jack in a residential home. Rear-receiving end **404** includes a pair of plug-receiving sockets **406** and **408**. Preferably plug-receiving socket **406** is for receiving a regular phone plug from a telephone device and plug-receiving socket **408** is for receiving a phone plug from a computing device. Further there are two sets of *n* conductors mounted in the housing. Each set, at one end, projects into a corresponding plug-receiving socket for engaging a contact of a phone plug when the phone plug is inserted into the plug-receiving socket. At the other end, the set for plug-receiving sockets **406** is coupled to plugging end **402** through a number of inductors, each for one conductor and the set for plug-receiving sockets **408** is directly coupled to plugging end **402**. As described above, there are two pairs of wires in a typical home phone line system. Therefore one version of phone plug **400** is to use four

inductors. To be more specific, there are respectively four conductors, at one end, projecting into each of the plug-receiving sockets in the rear-receiving end for engaging a contact of a regular residential phone plug when the phone plug is inserted. At the other end, the four conductors in the plug-receiving socket for telephone devices are respectively coupled to the plugging end (also including four conductors) through four inductors. In other words, a telephone device is coupled to the home line system through the inductors while a computing device is coupled directly to the home line system.

To continue the example above, it is assumed that the inductance L for each of the inductors is 50 μH. At 7.5 MHz, the impedance of the inductor is approximated:

$$\omega L = 2x\pi x7.5x10^{6}x50x10^{-6}) \approx 2.5k\Omega;$$

then the actual voltage received by the receiver is approximated:

$$1.2x(21+2500+2500)/(100+21+2500+2500) = 1.18\ V;$$

wherein the inductor is counted twice as each of the pair of conductors is conducted to an inductor. The result obtained above is close to the actual voltage available to the interface. In other words, the data signals received for data communication have not been considerably degraded.

It may be appreciated by those skilled in the art that the introduction of passive inductance circuits or simply inductors in the phone plug maintains the signals quality in data communication meanwhile the quality of voice communication is not affected.

Figure 4B shows an internal layout of improved phone plug **400**. When plugging end **402** is plugged into a phone jack **420**, connectors **432** and **434** in plug-receiving sockets **406** and **408** are coupled to phone line system **430** in which a data network is implemented. More specifically, each of connectors **432** in plug-receiving sockets **406** is coupled to one of the connectors in phone plug **400** through an inductor while connectors **434** are directly and respectively coupled to the connectors in phone plug **400**.

It should be pointed out that an improved phone plug **400** in **Figures 4A** and **4B** is a preferred embodiment that provides two plug-receiving sockets, one for the phone device and one for the computing device, optionally each being visually identified or labeled. In another embodiment, the rear-receiving end in phone plug **400** comprises one or more plug-receiving sockets, all for telephone devices. In this case, all the connectors in the plug-receiving sockets are coupled to the plugging end through an array of inductors on a one-to-one basis or two-to-one basis. The one-to-one basis means that each of the conductors in the plug-receiving socket is connected to an inductor while the two-to-one basis means that, for each pair of conductors in the plug-receiving socket, only one inductor is used, namely one of the two conductors is connected to the inductor.

The present invention has been described in sufficient detail with a certain degree of particularity. It is understood to those skilled in the art that the present disclosure of embodiments has been made by way of examples only and that numerous changes in the arrangement and combination of parts may be resorted without departing from the spirit and scope of the invention as claimed. Accordingly, the scope of the present invention is defined by the

appended claims rather than the forgoing description of embodiments.